Nutrient Intakes Among Dietary Supplement Users and Nonusers in the Food Stamp Population

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This study characterized the nutrient intakes of participants in the Food Stamp Program (FSP) who used nutrient supplements, compared with those who did not, and examined the variation in these relationships across different socio-demographic subgroups. Dietary intakes from food sources for eight key nutrients were examined from the 1994-96 Continuing Survey of Food Intakes by Individuals. Two measures of overall diet quality were also included in the analysis. Findings revealed that supplement use in FSP participants was positively associated with nutrient densities for iron, calcium, fiber, folate, vitamin A, and vitamin C and with overall diet quality. However, the direction and magnitude of this association varied across age, gender, and ethnic groups for iron, saturated fat, fiber, vitamin A, and one measure of overall diet quality (Z-score). Thus, results show that supplement use is not uniformly associated with more healthful diets among FSP participants.

The U.S. marketplace for dietary supplements is large and changing rapidly. National surveys indicate that dietary supplements are used by roughly 50 percent of the U.S. population (Balluz, Kieszak, Philen, & Mulinare, 2000; Slesinsky, Subar, & Kahle, 1995). Industry sources suggest that sales of all forms of supplements combined—including nutrients, herbals, sports products, and meal supplements—rose from $8.6 billion in 1994 to $16 billion in 2000 (Heasman & Mellentin, 2001). During that same period, sales of nutrient supplements, specifically, rose from $3.9 billion to $6.1 billion. This rise in consumption of dietary supplements is only the beginning of a much larger "functional foods revolution" built upon the development and marketing of a wide variety of supplements, genetically engineered foods, fortified foods, and conventional foods with compositional properties that are perceived or marketed as having links to improved health, performance, or well-being (Heasman & Mellentin, 2001). The U.S. market for functional foods is estimated to rise from about $20 billion in 2000 to $50 billion by 2010 (Government Accounting Office [GAO], 2000).

The rapid rise and high prevalence of supplement use in the United States stand in marked contrast to the views and positions of professional and scientific nutrition communities. Organizations such as the American Dietetic Association (ADA) (Hunt, 1996), the Dietary Guidelines for Americans Advisory Committee (U.S. Department of Agriculture [USDA] & U.S. Department of Health and Human Services [DHHS], 2000), and the Food and Nutrition Board of the Institute of Medicine (IOM, 1994) have maintained that most individuals can and should obtain all necessary nutrients in adequate amounts from a varied diet and that supplements are needed only in special circumstances. The position of the ADA regarding supplementation is that

> the best nutritional strategy for promoting optimal health and reducing the risk of chronic disease is to obtain adequate nutrients from a wide variety of foods. Vitamin and mineral supplementation is appropriate when well-accepted, peer-reviewed, scientific evidence shows safety and effectiveness. (Hunt, 1996, p. 73)

Notwithstanding the views of the ADA, the Food and Drug Administration (FDA), and other professional and scientific bodies, Congress created the Dietary Supplement Health and Education Act in 1994 that has little or no requirement for manufacturers to demonstrate the safety and efficacy of dietary supplements and is more permissive than conventional foods regarding the claims that marketers can make about the benefits of these products. In a recent report, the GAO (2000) concluded that the

> FDA's efforts and federal laws provide limited assurances of the safety of functional foods and dietary supplements [and] . . . we also found that agencies' efforts and federal laws concerning health-related claims on product labels and in advertising provide limited assistance to consumers in making informed choices and do little to protect them against misleading and inaccurate claims. (pp. 4-5)

While nutrient supplements taken in moderation do not raise the same safety concerns as do herbals and other dietary supplements, they do raise two other issues. One is their low efficacy in individuals and populations that do not suffer from nutrient deficiencies (USDA, 1999). In such cases, the exaggerated marketing claims regarding their benefits may mislead some consumers. While most studies show that supplement use is more common among Whites, women, those with higher levels of education, and those with higher incomes (USDA, 1999; Koplan, Annest, Layde, & Rubin, 1986; Lyle, Mares-Perlman, Klein, Klein, & Greger, 1998; Pelletier & Kendall, 1997), usage is not restricted to those groups. For instance, analysis of the 1994-95 Continuing Survey of Food Intakes by Individuals (CSFII) reveals that supplements were used by 49 percent of higher income individuals (greater than 130 percent of the poverty line) and 36 percent of lower income individuals (USDA, 1999).

The second issue related to nutrient supplements is whether they are used as true supplements for an already healthful diet or as a substitute for such a diet. This is important because of the wide range of health-promoting substances contained in whole foods, compared with supplements, which still are far from being understood fully. Most studies have shown that supplement users, compared with nonusers, tend to have higher vitamin and mineral intakes from food (Koplan et al., 1986; Looker, Sempos, Johnson, & Yetley, 1998; Lyle et al., 1995), suggesting a *supplementing* effect rather than a *substitutive* effect. Those studies have, however, assumed that such a finding applies equally to all consumers. The one study that examined potential heterogeneity in that relationship revealed that supplement use is associated with more healthful food intakes in some population groups but also is associated with less healthful food intakes in other groups defined by sociodemographic or attitudinal characteristics (Pelletier & Kendall, 1997).

The present study was initiated within the context of a rapidly expanding dietary supplement industry, a permissive set of laws and regulations, continued uncertainty regarding safety and efficacy, and questions concerning the positive or negative relationships between supplement use and the quality of food intake. The specific motivation for the study was the proposal considered by Congress on numerous occasions in the last decade to permit the use of food stamps to purchase nutrient supplements. This proposal was included in a House bill leading up to the welfare reform effort in 1996 (H.R.104-236) and more recently in a Senate bill (S.1731) leading up to the 2002 Farm bill. The proposal has yet to be incorporated into legislation on these and other occasions.

An expert committee of the Life Sciences Research Office (LSRO, 1998) and the USDA (1999) raised a number of concerns regarding this proposal, including evidence that nutrient intakes of FSP participants are similar to those of the general population, that most FSP participants can and do purchase supplements with income other than food stamps, and that administrative complications associated with the proposed change are considerable. In addition, the LSRO report noted a lack of research-based information concerning the relationship between supplement use and dietary intake among FSP participants.

This study examined the associations between supplement use and nutrient intakes from food among FSP participants, as well as the extent to which these associations are uniform across all sociodemographic subgroups of the FSP population.

Methods

Data and Sample

The data used in this study were derived from the 1994-96 CSFII. The CSFII, a national survey of dietary intake conducted by the USDA, is weighted to reflect a nationally representative sample of noninstitutionalized persons living in the United States (Tippett, Enns, & Moshfegh, 1999). The present study examined the first recalled day for the 16,103 respondents who provided at least 1 day of dietary data. The focus of this research was on nutrient intake exclusively from food sources. As defined by the 1994-96 CSFII, food intake does not include vitamins, minerals, or other supplements. Thus, the nutrient intakes analyzed here reflect these caveats.

Only 9,468 records were used in this analysis. The respondents excluded from the analysis were less than 18 years old; other than Hispanic, Black, or White; and had missing records or erroneous data. For the final sample, 886 were FSP participants and 8,582 were FSP nonparticipants.

Variables and Transformations

Much of the methodology used in this study followed very closely the methods of an earlier study by Pelletier and Kendall (1997). The dietary data used in this analysis were based on a single 24-hour recall for each participant. To account for differences in total energy intake, we used the 1-day dietary recall nutrient data for the eight key nutrients (total fat, saturated fat, iron, calcium, fiber, folate, vitamin A, and vitamin C), which were expressed in proportion to total kilocalories consumed and are referred to here as nutrient densities. Such nutrient indices are more indicative of overall diet quality and make comparison among records easier. Because of the assumption that data are normally distributed, which is implicit in many standard statistical tests such as the *t* and F tests as used in the present analysis, various transformations were used to ensure that individual nutrient data represented a normal distribution. A square root was used to transform fiber and vitamin C intakes while a natural log transformation was applied to folate, calcium, iron, and vitamin A. Because total fat and saturated fat data were normally distributed, they were not transformed.

In addition to the eight individual nutrient density variables, we included two additional variables in the regression to test the overall quality of each respondent's diet. An average diet score (index) was calculated from the Z-score values of the eight key nutrients. This average Z-score reflects the quality of the diet with respect to these key nutrients and, as such, may provide different information than any single nutrient considered alone. By using the full dataset of 9,468 individuals that included FSP participants and nonparticipants, we were able to calculate average intake values that were representative of the entire U.S. population. Subsequently, intake values of smaller subgroups could be compared with those of the whole population. The sign of the Z-score was reversed for total and saturated fat, prior to summing across all nutrients, to maintain consistency in the interpretation of this index.

Another computed variable used to measure overall diet quality was the Healthy Eating Index (HEI). The HEI was developed by the USDA's Center for Nutrition Policy and Promotion to assess and monitor the dietary status of Americans in accordance with the Food Guide Pyramid and the Dietary Guidelines for Americans (Variyam, Blaylock, Smallwood, & Basiotis, 1998). Each of the 10 components of the HEI has a maximum score of 10 and a minimum score of 0. High component scores indicate intakes close to recommended ranges or amounts; low component scores, less compliance. The present analysis used the five Food Guide Pyramid components of the HEI, which reflect how well each person incorporated the desirable number of servings from each of the five food groups on the recalled day. These five components were averaged together to achieve a mean value for each person. It is important to note that unlike the Z-score index, the HEI was not adjusted for energy intake or the quantity of food intake on the day of the recall.

Sociodemographic variables consisted of age, gender, education, employment status, and ethnicity. Ethnicity was coded as non-Hispanic Whites ("Whites"), non-Hispanic Blacks ("Blacks"), and anyone reporting Hispanic origin ("Hispanic"). The reference (omitted) groups in the regression analyses were 50 years and older (age), female (gender), less than high school (education), unemployed (employment status), and White (ethnicity).

Nutrient supplement use was defined based on the response to this question: "How often, if at all, do you take any vitamin supplement in pill or liquid form?" Because of sample size considerations, we defined users as those reporting the use of any type of supplement "every day or almost every day" or "every so often," and we defined nonusers (the reference group) as those reporting "not at all."

Data Analysis

The relationships among dietary intake, supplement use, and sociodemographic characteristics in the population of FSP participants were examined by using multiple regressions.

. . . among FSP nonparticipants, supplement use was more common among Whites, women, persons 50 years and older, and those with a college degree or more.

Table 1. Supplement use based on the various sociodemographic characteristics of the U.S. population, CSFII 1994-96

Variable	Total sample (n = 9,468)	Non-food stamp recipients (n = 8,582)	Food stamp recipients (n = 886)
		Percent users[1]	
Ethnicity			
White	51	52	40
Black	37	39	32
Hispanic	41	43	29
Gender			
Female	55	57	41
Male	42	43	26
Age			
18-49 years	47	48	43
50 years and older	52	53	33
Education			
Less than high school	36	37	32
High school or some college	48	49	35
College degree or more	59	59	55
Employment status			
Unemployed	48	49	35
Employed	49	51	36

[1]Percentages are weighted. Some percentages may not total to 100 because of rounding.

- Main-effects models tested whether the (generally) positive association between supplement use and dietary intake could be accounted for by socio-demographic variables. Each nutrient and the two measures of overall dietary quality were used as a dependent variable in its own model, and the association of supplement use to the dependent variable was observed before and after adjusting for the set of sociodemographic variables (ethnicity, gender, age, education, and employment status).

- Interaction models tested whether the strength or direction of the association was uniform across ethnicity, gender, and age while controlling for education and employment status. This was accomplished by testing the significance of an entire block of interactions between supplement use and ethnicity, gender, and age after controlling for the above-mentioned variables. These analyses included models with only 2-way interaction terms and, in separate runs, models with both 2-way and 3-way interaction terms.

These statistical methods were designed to permit a valid test of the hypothesis that the strength or direction of the association between supplement use and nutrient density from food among FSP participants is uniform across groups defined by socio-demographic characteristics. In this study, such a test was obtained by comparing the proportion of variance explained by either the 2-way model versus the main-effects model, the full 3-way model versus the main-effects model, or the full 3-way model versus the 2-way model. Because the table of model coefficients is difficult to interpret in the presence of higher

Table 2. Nutrient densities from the food consumed by supplement users and nonusers participating in the Food Stamp Program

	User	Nonuser
	Adjusted means[1]	
Fat (% kcal)	33.3	33.6
Saturated fat (% kcal)	11.0	11.3
Iron (mg/1,000 kcal)[3**]	7.4	6.7
Calcium (mg/1,000 kcal)[3*]	335.8	302.4
Fiber (g/1,000 kcal)[2**]	8.1	7.0
Folate (mcg/1,000 kcal)[3*]	116.2	101.7
Vitamin A (RE/1,000 kcal)[3*]	328.8	271.1
Vitamin C (mg/1,000 kcal)[2*]	48.0	41.7
Z-score average[4**]	0.02	-0.15
HEI average[**]	5.7	5.2

[1]Models for calculating adjusted means consist of age, gender, ethnicity, education, and employment status, as well as a dummy variable to indicate supplement use.
[2]Square root transformation applied in regression; geometric means are shown for ease of interpretation.
[3]Natural log transformation applied in regression; geometric means are shown for ease of interpretation.
[4]Z-scores were based on the total sample (n = 9,468), including FSP participants and nonparticipants.
*$p < 0.05$.
**$p < 0.001$.
n = 309 users and 550 nonusers.

order interaction terms, graphs were used to present differences in the direction and magnitude of the association of supplement use with nutrient densities.

Although SUDAAN generates more accurate variance estimates for surveys with complex sample structures like the CSFII, SAS was used to analyze the data because they were better suited for estimating the statistical interactions involving supplement use.

Results

In the total CSFII sample[1] and among FSP nonparticipants, supplement use was more common among Whites, women, persons 50 years and older, and those with a college degree or more (table 1).

[1]Results for the total sample are shown for comparison.

Over half (51 to 59 percent) of those in each socioeconomic group used supplements. Similar patterns were found among FSP participants, except that supplement use was more common in the younger age group (18 to 49 years). FSP participants had consistently lower supplement use than did nonparticipants in each of the sociodemographic groups (40 to 55 percent vs. 52 to 59 percent). Employment status appeared to have little association with supplement use.

When age, gender, education, employment status, and ethnicity were controlled, results showed that supplement users had statistically higher vitamin and mineral densities from food than did nonusers (table 2). The density for each of these nutrients was roughly 10 to 20 percent higher in the diets of supplement users than in the diets of nonusers. Also, in this study, the two groups had very similar densities of fat and saturated fat, contrasting with the earlier study of the general CSFII sample (1989-91) that found significantly lower total fat and saturated fat density among supplement users (Pelletier & Kendall, 1997). Both measures of diet quality, the Z-score average and the HEI average, showed statistically more healthful diets among supplement users than among nonusers.

Regression coefficients for all the variables in the main-effects models (table 3) that were used to generate the adjusted means in table 2 demonstrated the more favorable nutrient profiles for supplement users. In addition, the results based on the main-effects models revealed patterns among various subgroups within the group of FSP participants:

- Males, compared with females, had significantly higher densities of total fat, lower densities of vitamin C, and lower Z-scores for overall diet quality.
- Individuals less than 18 to 49 years old, compared with those 50 years old and over, had significantly higher densities of saturated fat and lower densities of iron, fiber, folate, vitamins A and C, as well as lower Z-scores.
- Hispanics, compared with Whites, had higher densities of fiber, folate, and vitamin C and higher Z-scores; Blacks, compared with Whites, had significantly lower densities of calcium, folate, and vitamin A but higher densities of vitamin C.
- Employed individuals, rather than unemployed individuals, had significantly lower densities of iron and calcium and lower Z-scores.

Table 3. Regression coefficients of the main-effects model for Food Stamp Program participants

Variable	Total fat	Saturated fat	Iron	Calcium	Fiber	Folate	Vitamin A	Vitamin C	Diet score Z average	HEI average
Main Effects[1]										
Intercept	***0.3336	***0.1129	***-4.8460	***-0.8910	***2.9970	***-2.0116	***-0.8367	***0.2081	**0.1568	***4.8784
Supplement user	-0.0026	-0.0029	***0.0928	*0.1048	***0.1971	**0.1332	**0.1930	*0.0150	***0.1721	***0.4375
Male	**0.01876	0.0052	-0.0125	-0.0121	-0.0708	-0.0501	-0.0856	***-0.0264	**-0.1141	***0.5277
18-49 years	0.0078	*0.0070	***-0.1271	-0.0399	***-0.3877	***-0.2306	***-0.2797	**-0.0252	***-0.2631	0.0839
Hispanic	-0.0025	-0.0031	0.0529	-0.0315	***0.2490	*0.1309	0.1133	***0.0525	***0.1701	***0.6401
Black	-0.0037	-0.0041	0.0244	***-0.2360	-0.1040	*-0.0962	*-0.1718	**0.0205	-0.0780	0.0182
Employed	0.0055	-0.0009	**-0.0758	***-0.1331	0.0111	-0.0800	-0.1260	-0.0093	*-0.1041	-0.0180
High school/ some college	***-0.0231	**-0.0090	0.0417	**-0.1059	-0.0133	-0.0019	-0.0630	0.0054	0.0404	0.1654
College or more	*-0.0267	-0.0089	0.0152	0.0775	0.0869	0.0856	0.0315	**0.0463	*0.1805	*0.6052
R^2	.0242	.0217	.0505	.0844	.0839	.0657	.0512	.0779	.1051	.0556

[1]Main effects are shown in relation to the reference (omitted) group within each variable: Female (Gender), 50 years and older (Age), White (Ethnicity), Unemployed (Employment status), and Less than high school (Education).
*p < 0.05, ** p < 0.01, ***p < 0.001.
n = 859.

Table 4. Test of uniformity in the association between supplement use and nutrient intakes among Food Stamp Program participants: 2-way and 3-way interaction models[1]

Variable	Total fat	Saturated fat	Iron	Calcium	Fiber	Folate	Vitamin A	Vitamin C	Diet score Z average	HEI average
R^2 for main-effects model	.0242	.0217	.0505	.0844	.0839	.0657	.0512	.0779	.1051	.0556
R^2 for 2-way model	.0273	.0293	.0779	.0935	.1004[2]	.0771	.0698	.0837	.1136	.0681
R^2 for 3-way model	.0371	.0430[4]	.0882[3,4]	.0946	.1020	.0836	.0780[3]	.0866	.1237[4]	.0701

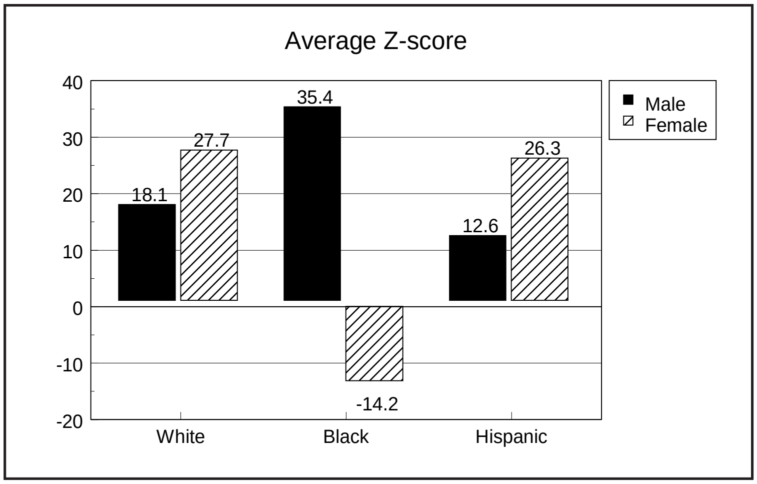
[1]Two-way models involved interaction terms between supplement use and ethnicity, age, or gender; 3-way models involved interaction terms between supplement use and any two of these variables.
[2]Two-way versus main-effects model; R^2 difference significant at p = .084 (fiber).
[3]Three-way versus main-effects model; R^2 difference significant at p = .005 (iron) and p = .0458 (vitamin A).
[4]Three-way versus 2-day interaction model; R^2 difference significant at p = .0375 (saturated fat), p = .0959 (iron), and p = .0890 (Z average).
n = 859.

- High school graduates tended to have more healthful diets as suggested by lower fat densities and higher composite diet scores than did non-high school graduates, but the patterns of means and statistical significance were not consistent across all nutrients.

Overall, these results suggest a complex and varying set of relationships existing between socio-demographic characteristics and nutrient densities from food, even before interaction terms were added to the models.

To test for the uniformity of the association between supplement use and nutrient density from food across major population groups, we sequentially added interaction terms involving the "user" variable to the main-effects model (table 4). Two-way interactions were first added, then blocks of 2-way and 3-way interactions were added in sequence. The statistical test of significance was based on the F statistic for the R^2 improvement, as each block of interaction terms was added to the model. Overall, the test of uniformity in the association between supplement use and nutrient density was rejected for four of the eight individual nutrients (saturated fat, iron, fiber, and vitamin A) and for one

Figure 1. Percent difference in average Z-score between supplement users and nonusers among Food Stamp Program participants, by ethnic and gender groups (adjusted for employment status and education)



Among older Whites and older Hispanics, supplement use was associated with more healthful nutrient profiles for iron, vitamin A, saturated fat, and the composite Z-score. However, this pattern was not evident among older Blacks where little or no association existed between supplement use and mean nutrient densities.

of the composite diet scores (Z-score). Saturated fat, iron, vitamin A, and the Z-score had significant 3-way interactions; whereas, only fiber had a significant 2-way interaction. The test of uniformity in the relationship between supplement use and nutrient density could not be rejected for total fat, calcium, folate, vitamin C, or the HEI average. Overall, these results suggest that, with respect to certain nutrients and one of the composite diet scores, the strength or direction of the association between supplement use and nutrient density was not uniform across all subgroups within the sample of FSP participants.

Based on the equations from the above analyses, we generated a series of predicted means to facilitate interpretation of the interactions. These predicted means revealed the magnitude and direction of the difference in nutrient density among supplement users versus nonusers across major FSP subgroups. These differences are summarized in figures 1 and 2. These figures display the mean difference in nutrient densities for supplement users versus nonusers in each socio-demographic group, expressed as a percentage of the mean for nonusers in that group. This was done to aid the interpretation of the regression coefficients and to further standardize the comparison across nutrients.

Figure 1 reveals that the basis for the 3-way interaction involving ethnicity, gender, and supplement use is that nutrient densities for Black females do not show the same pattern as in the other groups. As shown here for the Average Z-score, five of the ethnicity x gender groups had positive Difference scores, indicating that in each of these groups, supplement use was associated with more healthful nutrient density profiles. By contrast, Black females had a negative Difference score, indicating that supplement use in that group was associated with a less healthful nutrient profile. The patterns for iron, vitamin A, and saturated fat densities were similar (data not shown).

Figure 2. Percent difference in mean nutrient intakes between supplement users and nonusers among Food Stamp Program participants, by ethnic and gender groups (adjusted for employment status and education)

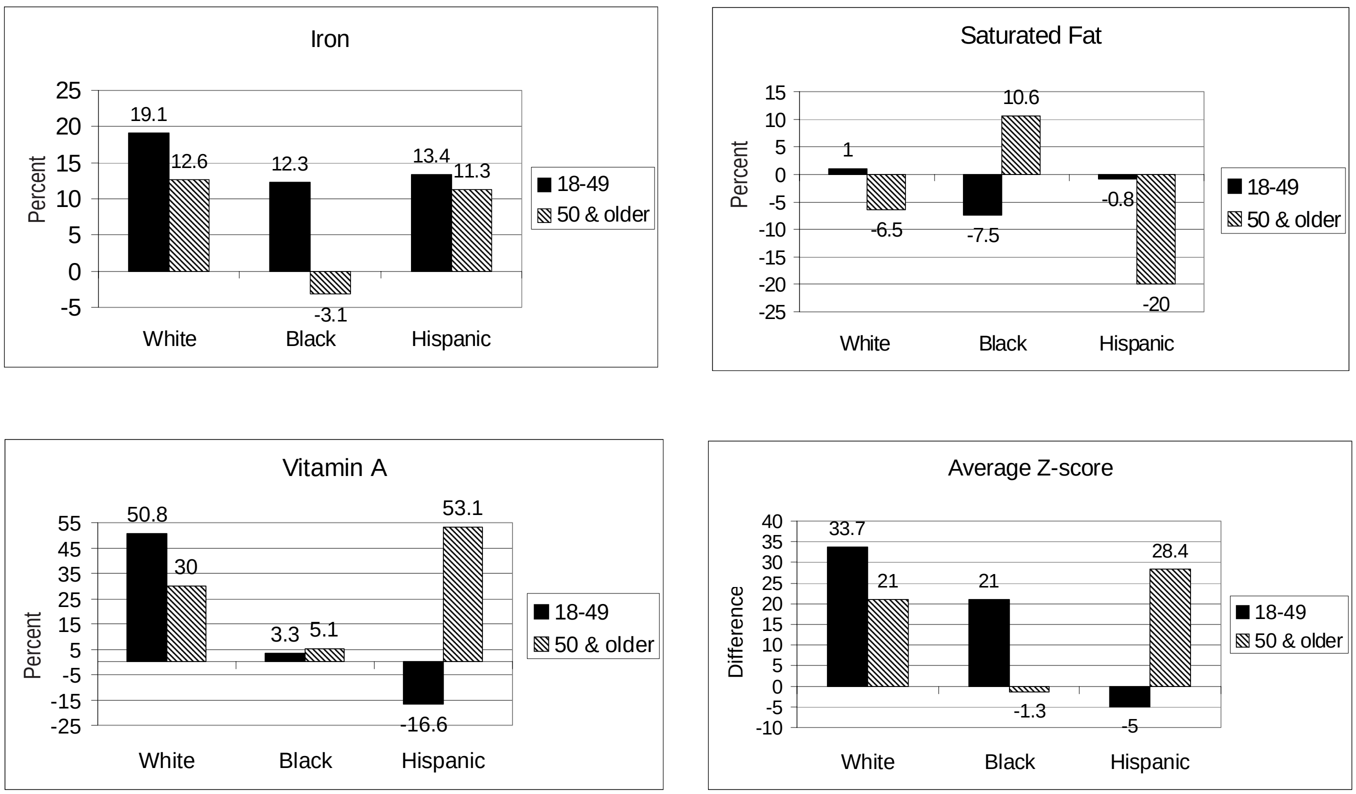


Figure 2 illustrates the basis for the 3-way interaction involving ethnicity, age, and supplement use. In this case, the relationships were more complex than those shown in figure 1. Among older Whites and older Hispanics, supplement use was associated with more healthful nutrient profiles for iron, vitamin A, saturated fat, and the composite Z-score. However, this pattern was not evident among older Blacks where little or no association existed between supplement use and mean nutrient densities.

Among younger Whites and younger Blacks, supplement use was associated with a more healthful composite Z-score (33.7 and 21.0 difference, respectively); among younger Hispanics, there was little or no association (-5 difference). However, in this case, the composite Z-score obscured significant variation with respect to individual nutrients. Thus, the positive Z-score difference for younger Blacks was a result of supplement users, compared with nonusers, having higher iron densities and lower saturated fat densities. Among younger Whites, the positive Z-score difference was a result of supplement users, compared with nonusers, having higher iron and vitamin A densities. Among younger Hispanics, the near-zero (-5) Z-score difference was a result of supplement users, compared with nonusers, having higher iron density but lower vitamin A.

While the above analyses pertaining to the 3-way interactions were sufficient to reject the hypothesis of uniformity in the association between supplement use and nutrient density from food, they were not adequate for exploring the social or behavioral basis for the differences observed. Further insight might be gained by testing more complete models, including higher level interactions with education, geographic location of residence, and other variables.

Discussion

There are two major findings from our research. First, among FSP participants, supplement use is positively associated with nutrient densities from food for iron, calcium, fiber, folate, vitamins A and C, and with two composite diet quality scores (average Z-score and average HEI). These associations remain statistically significant after accounting for age, gender, ethnicity, education, and employment status. In contrast to findings in the general population (Pelletier & Kendall, 1997), total fat and saturated fat densities are not significantly related to supplement use among FSP participants. Second, while these trends are evident for the FSP population as a whole, the interaction analysis reveals that the direction and strength of the association between supplement use and nutrient density vary significantly across age, gender, and ethnic groups for iron, saturated fat, fiber, vitamin A, and Z-score average. These findings are consistent with the results of parallel statistical analyses pertaining to the overall U.S. population (Pelletier & Kendall, 1997) and confirm the existence of significant heterogeneity in the relationship between supplement use and nutrient densities from food.

The present study has a number of strengths and limitations that should be considered when interpreting these findings. The strengths consist of the following:

- the analysis focused on the FSP participant population, which is precisely the population of interest in the policy proposals considered by Congress;
- the FSP sample was drawn from a nationally representative survey sample (CSFII) based on a standardized survey methodology;
- the analysis was restricted to nutrients of key public health concern in the United States; and
- the analysis formally explored statistical interactions, which few other studies on this subject have done.

The limitations of this study include use of the following:

- a cross-sectional survey rather than a longitudinal and/or experimental design;
- a single dietary recall for each subject, which is a poor measure of usual intake for individuals;
- small sample sizes in some of the cells used in the interaction analysis; and
- a dichotomous variable (yes/no) to measure supplement use, which does not fully capture the variation in usage related to type of supplement, frequency, regularity, and dosage.

In addition, the nutrient density indices in this study are appropriate for examining overall diet quality but are not intended to indicate dietary adequacy. The latter would require comparison with Dietary Reference Intakes or other external standards.

While it is important to acknowledge the above limitations, in statistical terms, the net effect of the problems related to dietary recall, sample size, and the dichotomous usage variable is to *reduce* the power of this study to find statistically significant associations and interactions between supplement use and nutrient density from food. Thus, while these considerations could have been invoked as possible explanations for *negative* findings (i.e., no statistically significant interactions), they cannot be invoked as an explanation for the *positive* findings reported here. To the contrary, the latter three methodological limitations imply that the true (unobservable) interactions may be larger in number and stronger in magnitude than those reported here.

Another methodological consideration is that the present analysis is focused on the mean nutrient densities of foods consumed by various subgroups. From a policy perspective, the greatest concern may be with those individuals at the lower end of the nutrient intake distributions rather than with those whose intakes are at the mean. Some insight into this issue might be gained in future studies by undertaking distributional analyses of the larger CSFII sample, which represents the general population. In addition, future studies should investigate whether interactions of the type noted here, in relation to nutrient density, may be due to variation in energy intake, physical activity, or other factors not measured here.

Finally, it is important to reiterate that the variations in nutrient density documented here, and in a previous study (Pelletier & Kendall, 1997), are important not only in relation to the particular nutrients studied but also because they are assumed to reflect systematic variations in patterns of food intake among supplement users and nonusers of different socio-demographic groups. This is a significant distinction, because chronic disease tends to be associated more closely with long-term patterns of food intake than with the intake of individual nutrients or supplements (National Research Council [NRC], 1989).

Policy Implications

This study highlights the pitfalls of assuming that statistical averages observed in the general population can be applied to all of its subgroups. This assumption is illustrated by one of the claims made commonly by representatives of the supplement industry (Council for Responsible Nutrition [CRN], 1998, 2002):

> In general, supplement users are healthy people who view supplements as just one of several approaches for improving health. There is no evidence that supplement users rely on supplements as a substitute for improving dietary habits. In fact, surveys show that supplement users tend to have somewhat better diets than [do] nonusers (Koplan, 1986; Looker, 1988; Hartz, 1988; Slesinsky, 1996). This suggests that consumers who use supplements are also paying more attention to their overall nutritional habits. Even so, these consumers have nutrient shortfalls in their diets, and supplements can help fill those gaps. (CRN, 2002, p. 14)

In contrast to these claims, a body of research now exists which suggests that in some U.S. sociodemographic groups, supplement use is associated with more healthful diets, and in some groups, supplement use is associated with less healthful diets. This pattern is found in the general U.S. population (Pelletier & Kendall, 1997) as well as among participants in the FSP (present study). In theory, however, these patterns may exist either because supplements are being used to substitute for healthful diets or because supplement users are a self-selected group. Although existing analyses of national survey data are not adequate for distinguishing between these two explanations, qualitative research with participants in the FSP reveals a common belief that supplements are intended to be a replacement or substitute for food (Kraak et al., 2002).

The accumulated evidence highlights a logical fallacy underlying one of the common arguments for permitting the use of food stamps to purchase nutrient supplements. The logical fallacy is that statistical averages observed from cross-sectional survey data from the general population apply equally to all subgroups within the population and, moreover, that such averages can be used to predict the response of the general population as well as a low-income population (e.g., FSP participants) to changes in policy. This present study adds to the broader body of evidence and rationales provided by an expert committee (LSRO, 1998) and a USDA report (1999), suggesting that any potential benefits of permitting the purchase of supplements with food stamps are outweighed by the risks, administrative complications, and uncertainties. The repeated failure of proposed legislation for changing FSP policy regarding nutrient supplements (e.g., H.R.104-236 and S.1731) suggests that policymakers may agree with this assessment.

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